

AIR FORCE QUALIFICATION TRAINING PACKAGE (AFQTP)



**FOR
ELECTRICAL POWER PRODUCTION
(3E0X2)**

**MODULE 26
AUTOMATIC TRANSFER SWITCHES**

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CORRECTIONS/IMPROVEMENT LETTER..... APPENDIX A

Career Field Education and Training Plan (CFETP) references from 1 Aug 02 version.

OPR: HQ AFCESA/CEOF
(SMSgt Michael A. Trevino)
Supersedes AFQTP 3E0X2-14, 1 Oct 1999

Certified by: HQ AFCESA/CEO
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FOR
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INTRODUCTION

Before starting this AFQTP, refer to and read the “[AFQTP TRAINER/TRAINEE GUIDE](#).”

AFQTPs are mandatory and must be completed to fulfill task knowledge requirements on core and diamond tasks for upgrade training. ***It is important for the trainer and trainee to understand*** that an AFQTP ***does not*** replace hands-on training, nor will completion of an AFQTP meet the requirement for core task certification. AFQTPs will be used in conjunction with applicable technical references and hands-on training.

AFQTPs and Certification and Testing (CerTest) must be used as minimum upgrade requirements for Diamond tasks.

MANDATORY minimum upgrade requirements:

Core task:

AFQTP completion
Hands-on certification

Diamond task:

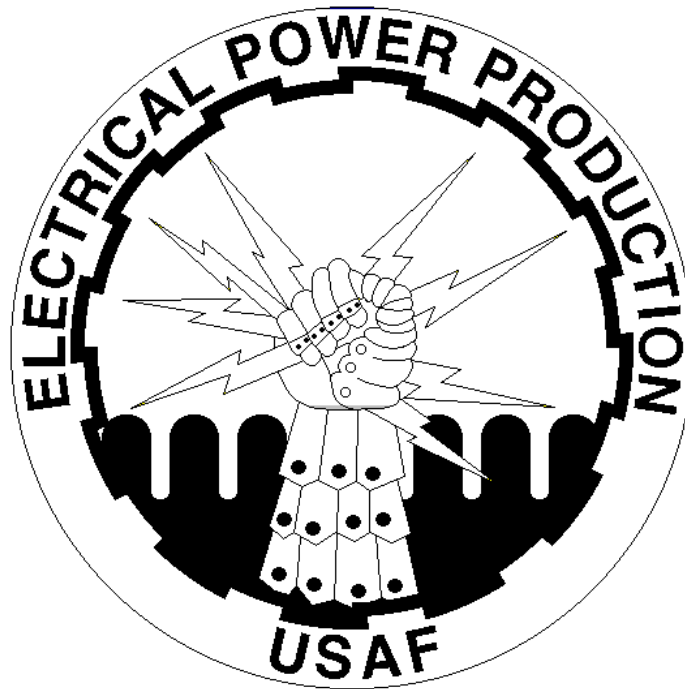
AFQTP completion
CerTest completion (80% minimum to pass)

Note: *Trainees will receive hands-on certification training for Diamond Tasks when equipment becomes available either at home station or at a TDY location.*

Put this package to use. Subject matter experts under the direction and guidance of HQ AFCESA/CEOF revised this AFQTP. If you have any recommendations for improving this document, please contact the Career Field Manager at the address below.

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AUTOMATIC TRANSFER SWITCHES

MODULE 26

AFQTP UNIT 3

**DETERMINE COMPATIBILITY BETWEEN TRANSFER
SWITCH, GENERATOR, AND ELECTRICAL SERVICE (26.3.)**

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DETERMINE COMPATIBILITY BETWEEN TRANSFER SWITCH, GENERATOR, AND ELECTRICAL SERVICE

Task Training Guide

STS Reference Number/Title:	26.3., Determine compatibility between transfer switch, generator, and electrical service.
Training References:	<ol style="list-style-type: none"> 1. Career Development Course (CDC) Electrical Power Production Journeyman 3E052B, Volume 2, Unit 2-2, Section 206: <i>Automatic Transfer Panels.</i> 2. CD-ROM Air Force Qualification Training Package (AFQTP) 3E0X2 Electrical Power Production, Version 1.0, Nov 97: <i>Automatic Transfer Panels.</i> 3. Manufactures Manuals.
Prerequisites:	<ol style="list-style-type: none"> 1. Possess as a minimum a 3E032 AFSC. 2. Review the following references: <ol style="list-style-type: none"> 1.1. Review CDC Electrical Power Production Journeyman 3E052B, Volume 2, Section 206. 1.2. Manufactures Manuals 3. Complete CD-ROM AFQTP 3E0X2 Electrical Power Production, Version 1.0, Nov 97: <i>Automatic Transfer Panels.</i>
Equipment/Tools Required:	<ol style="list-style-type: none"> 1. Computer to support AFQTP CD-ROMs. 2. Applicable manufactures references. 3. Automatic Transfer Switch (ATS) specifications. 4. Generic generator set. 5. Personal safety equipment.
Learning Objective:	Determine the compatibility between transfer switch, generator, and electrical service.
Samples of Behavior:	Student will be able to determine compatibility between transfer switch, generator, and electrical service
Notes:	In order to complete this AFQTP, the trainer will have to develop a training scenario.

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DETERMINE COMPATIBILITY BETWEEN TRANSFER SWITCH, GENERATOR, AND ELECTRICAL SERVICE

1. Background: The automatic transfer switch (ATS) is basically an automatic double-throw power panel, used to protect critical electrical loads against loss of power. The ATS is connected to a normal and emergency power source, and supplies a electricity to a common load. In the event of power loss from the normal source, the ATS will sense the loss of power, start the emergency generator and automatically transfer the load to the emergency source. The reverse will occur when the normal power source returns. A series of timers and digital circuits control the sensing, timing, and physical transfer properties of the switch to meet facility standards.

1.1. This AFQTP will build a knowledge base on the compatibility between the automatic transfer switch, generator, and electrical service feeding a particular facility. Since not all units throughout the Air Force have Automatic Transfer Switches, a Civil Engineering scenario will be built around a failed Real Property Installed Equipment (RPIE) generator at a critical base facility.

2. Formulas: In order to determine compatibility between transfer switches, generators, and electrical services, the following formulas for 3-phase electricity have to be considered for calculations:

$$\text{Kilowatts} = \frac{\text{line voltage} \times \text{amperage/phase} \times \text{power factor} \times 1.73}{1000} \text{ or } \frac{(E) (I) (PF) (1.73)}{1000}$$

$$\text{Example \#1} - \frac{208 \text{ volts} \times 350 \text{ amps} \times .8 \times 1.73}{1000} = 100 \text{ kilowatts}$$

$$\text{Example \#2} - \frac{60 \text{ kilowatts} \times 1000}{208 \text{ volts} \times .8 \times 1.73} = 208 \text{ amps/phase}$$

3. Compatibility: In order to determine the compatibility between the transfer switch, generator and electrical service, we have to build a knowledge base on what they all have to have in common to be compatible.

SAFETY:

INCORRECT RATING COMPATIBILITIES MAY CAUSE SEVERE EQUIPMENT DAMAGE AND POSSIBLE LOSS OF LIFE AND LIMB!

3.1. To determine compatibility, follow these steps in order:

Step 1: All three (3) components have to have the same voltage rating. Whether you have 120/240 single phase, 277/480 3-phase, or any combinations, all components have to be rated for the same voltage in order to work correctly and meter properly.

Step 2: All three (3) components have to have the same frequency rating. Whether you have 50 or 60 Hertz, all components and loads have to have the same rating.

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Step 3: All three (3) have to be able to support the designated facility load.

3.1. *Transfer switch* has to be of sufficient amperage size (260 amp, etc.).

3.2. *Generator* has to be of sufficient kilowatt rating to support designated facility load (80 kilowatt, etc.) Generator also has to be able to use the same auxiliary fuel source for extended runs.

3.3. *Electrical service entrance* has to be of sufficient kilovolt-amp rating to support designated facility load (100 kilovolt-amp).

Step 4: All three (3) components have to have the same phase rotation for 3-phase systems.

Step 5: All three have to have sufficient wire size to feed the designated facility load.

3.2. Now that you have the basic knowledge of what the components have to have in common, let's look at the following scenario to put these steps to work for you.

Example Scenario: At base X, the 150-kilowatt, 120/208 volt, 3-phase wye RPIE generator feeding a 400 amp transfer switch at the Security Forces control center was running during a base-wide outage, and the alternator shot a fireball out the end-bell from a winding short. The generator cannot be fixed, the UPS just quit, and the 911 service is completely out of power. *What do you do?*

Replacement Equipment Available: You are now faced with getting the power restored to the control center, and here's what you have in the yard:

- a. Skid-mount 200-kilowatt MEP-009B set up for 277/480 volts.
- b. Mobile 100-kilowatt MEP-007B set up for 120/208 volts.
- c. Mobile 30-kilowatt MEP-005A set up for 120/208 volts.
- d. 50' pieces of 175-amp, 5-wire SO "baloney" power cable pigtails.

Solution: You check the generator records for the control center generator and notice that it has a maximum load of 80-kilowatts. That mobile MEP-007B would be a whole lot easier to get out since it's mobile and you won't have to get a crane to lift the MEP-009B. The only other problem is an 80-kilowatt generator runs 277amps/phase, which would overload a single 175-amp cable. There is nothing wrong with hooking two (2) sets of 175-amp cables in parallel for a combined rating of 277+ amps to run that load, though.

- a. You now have what it takes to power the control center. The voltages match; the frequencies can be matched; the transfer switch is of sufficient size for a 115-kilowatt generator, phase rotation would be taken care of on site, and the two (2) SO cables were sufficient for the load.
- b. The generator is now pulled to the site; ground from the MEP-007B was hooked to building ground; the power cables were hooked up black (L1), red (L2), blue (L3), white neutral, and green ground to the generator (clockwise) and ATS (clockwise). Start up the generator and close the contactor, and the control tower is back to controlling inbound aircraft with an 80-kilowatt load; 90-kilowatts on startup. The only problem is fuel; refuel schedule is coordinated for every 6 hours by Base Fuels!

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Mobile Generator Providing Power

Summary: Although this is only one scenario, all the factors of compatibility were covered. The bottom line is providing the best service to our customers, even if it means using some ingenious thinking outside the box!

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**REVIEW QUESTIONS
FOR
DETERMINE COMPATIBILITY BETWEEN TRANSFER SWITCH, GENERATOR, AND
ELECTRICAL SERVICE**

QUESTION	ANSWER
1. What could happen if the generator and electric service are incompatible?	a. Reduced generator efficiency. b. Higher than normal electric bill. c. Possible severe equipment damage. d. Nothing.
2. What do you do if you are connecting a generator to an ATS, and the wire size you have may only carry 75% of rated load?	a. Run generator anyway. b. Decrease frequency from 60 to 50 Hz. c. Double-up wire to handle load. d. Leave customer without power.
3. What happens at a facility equipped with an ATS and generator, when the electric service shuts off?	a. ATS only calls service call to alert standby personnel of outage. b. ATS signals generator to start, but not connect to the load. c. ATS pumps fuel to the generator. d. ATS signals generator to start, and connect to the load.

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DETERMINE COMPATIBILITY BETWEEN TRANSFER SWITCH, GENERATOR, AND ELECTRICAL SERVICE**PERFORMANCE CHECKLIST****INSTRUCTIONS:**

The trainee must satisfactorily perform all parts of the task without assistance. Evaluate the trainee's performance using this checklist.

DID THE TRAINEE....?	YES	NO
1. Compare all three (3) components to see if they had the same voltages rating		
2. Compare all three (3) components to see if they had the same frequency rating		
3. Compare all three (3) components to see if they will support the designated facility load		
4. Check all three (3) components to see if they had the same phase rotation		
5. List compatibility criteria between ATS, generator, and electrical service correctly		

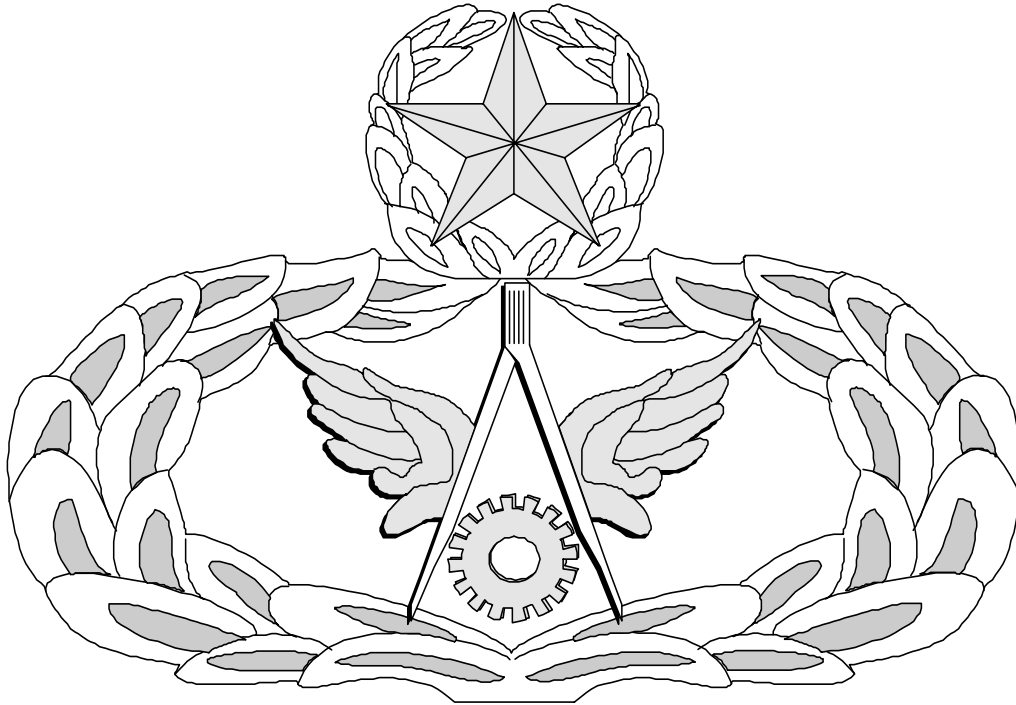
FEEDBACK: Trainer should provide both positive and/or negative feedback to the trainee immediately after the task is performed. This will ensure the issue is still fresh in the mind of both the trainee and trainer.

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Air Force Civil Engineer

QUALIFICATION TRAINING PACKAGE (QTP)

ANSWER KEY



FOR
ELECTRICAL POWER PRODUCTION
(3E0X2)

MODULE 26

AUTOMATIC TRANSFER SWITCHES

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Key-1

**DETERMINE COMPATIBILITY BETWEEN TRANSFER SWITCH, GENERATOR, AND
ELECTRICAL SERVICE.
(3E0X2-26.3)**

QUESTION	ANSWER
1. What could happen if the generator and electric service are incompatible?	c. Possible severe equipment damage.
2. What do you do if you are connecting a generator to an ATS, and the wire size you have may only carry 75% of rated load?	c. Double-up wire to handle load.
3. What happens at a facility equipped with an ATS and generator, when the electric service shuts off?	d. ATS signals generator to start, and connect to the load.

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MEMORANDUM FOR HQ AFCESA/CEOF
139 Barnes Drive Suite 1
Tyndall AFB, FL 32403-5319

FROM:

SUBJECT: Qualification Training Package Improvement

1. Identify module.

Module # and title _____

2. Identify improvement/correction section(s):

<input type="checkbox"/> STS Task Reference	<input type="checkbox"/> Performance Checklist
<input type="checkbox"/> Training Reference	<input type="checkbox"/> Feedback
<input type="checkbox"/> Evaluation Instructions	<input type="checkbox"/> Format
<input type="checkbox"/> Performance Resources	<input type="checkbox"/> Other
<input type="checkbox"/> Steps in Task Performance	

3. Recommended changes--use a continuation sheet if necessary.

4. You may choose to call in your recommendations to DSN 523-6392 or FAX DSN/Commercial 523-6488 or (850) 283-6488 or email ceof.helpdesk@tyndall.af.mil.
5. Thank you for your time and interest.

YOUR NAME, RANK, USAF
Title/Position